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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/826,661	04/05/2001	Yongjun Hu	303.098US4	4539

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EXAMINER

NGUYEN, JOSEPH H

ART UNIT PAPER NUMBER

2815

DATE MAILED: 04/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/826,661

Applicant(s)

HU, YONGJUN

Examiner

Joseph Nguyen

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 March 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 48-54, 71-73, 75, 76, 82-89, 91-100, 102, 103 and 105-116 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 48-54, 71-73, 75, 76, 82-89, 91-100, 102, 103 and 105-116 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 April 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claims 48, 50-54, 71-73, 75-76, 82-83, 85-89, 91-96, 98-100, 102-103, 105-106, 108-116 are rejected under 35 U.S.C. 102(e) as being anticipated by De Bruin.

Regarding claim 48, De Bruin discloses on figure 4 a contact hole 13 for a semiconductor device comprising a bottom surface of a first material 20; at least one vertical sidewall of a second material 11; a generally planar layer of a third material 15b covering only the bottom surface, the third material having a graded stoichiometry between a refractory metal and the first material.

Regarding claim 50, De Bruin discloses on figure 4 the first material 20 is silicon.

Regarding claim 51, De Bruin discloses on figure 4 the second material 11 is an insulator.

Regarding claim 52, De Bruin discloses on figure 4 the planar layer contacts the sidewalls.

Regarding claim 53, De Bruin discloses on figure 4 the third material 15b is substantially confined to the bottom of the hole.

Regarding claim 54, De Bruin discloses on figure 4 the third material is a silicide.

Regarding claim 71, De Bruin discloses on figure 4 in a semiconductor device, a contact hole 13 in a layer of insulator material 11 directly overlying on the substrate 20, the hole comprising a bottom surface having at least one generally planar layer of conductive material including a silicide of refractory metal 15b; a substrate having a profile that does not change significantly in the vicinity of the contact hole 13; and a vertical sidewall consisting substantially entirely of the aforementioned layer of insulator material 11.

Regarding claim 72, De Bruin discloses on figure 4 the planar layer contacts the lower end of the sidewall.

Regarding claim 73, De Bruin discloses on figure 4 the planar layer does not extend substantially up the sidewall from the bottom surface.

Regarding claim 74, De Bruin discloses on figure 4 the planar layer is an alloy or a composite.

Regarding claim 75, De Bruin discloses on figure 4 the planar is titanium silicide.

Regarding claim 76, De Bruin discloses on figure 4 the refractory metal is colbalt (col. 8, lines 22-26).

Regarding claim 82, De Bruin discloses on figure 4 in a semiconductor device having a substrate 20, a contact hole in a layer of insulator material 11 directly overlying the substrate, the hole comprising a vertical sidewall consisting substantially entirely of the aforementioned layer of insulator material 11; and a bottom surface having at least one generally planar bottom layer of conductive material 15b having a graded sotichiometry between two different constituent elements in the bottom layer.

Regarding claim 83, De Bruin discloses on figure 4 the substrate 20 is silicon and the insulator material 11 is a nitride.

Regarding claim 85, De Bruin discloses on figure 4 the conductive material includes a silicide of a metal.

Regarding claim 86, De Bruin discloses on figure 4 the metal is a refractory metal.

Regarding claims 87-89, 91-96, 98-100, 102-103, 105-106, 108-116, De Bruin discloses on figure 4 all the structures set forth in the claimed invention.

Claims 48, 50-54, 71-73, 75-76, 82-86, 98-100, 102-103, 105-116 are rejected under 35 U.S.C. 102(e) as being anticipated by Chen.

Regarding claims 48, 50-54, 71-73, 75-76, 82-86, 98-100, 102-103, 105-116, Chen discloses on figure 3B all the structures set forth in the claimed invention.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen as applied to claim 48 above, and further in view of Miyamoto.

Regarding claim 49, Chen discloses substantially all the structure set forth in the claimed invention except the hole having a high aspect ratio. However, Miyamoto discloses on figure 3 the hole having a high aspect ratio (col. 9, lines 3-8). In view of such teaching, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Miyamoto by having the hole having a high aspect ratio for the purpose of providing a good coverage over a surface of the silicon substrate.

Claims 87-89, 91-97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen.

Regarding claims 87-89, 91-92, Chen discloses substantially all the structure set forth in the claimed invention except a silicide refractory metal, the bottom layer extending into the substrate less than twice the distance from the top of the bottom layer to the top of substrate. However, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify Chen by a silicide refractory

metal, the bottom layer extending into the substrate less than twice the distance from the top of the bottom layer to the top of substrate for the purpose of improving the structure of a semiconductor device, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claims 93-97, Chen discloses substantially all the structure set forth in the claimed invention except the silicide extending below the top of the substrate a distance less than the equilibrium ratio of the metal and the substrate material times the thickness of the bottom layer above the top of the substrate. However, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify Chen by Regarding claims 87-89, 91-92, Chen discloses substantially all the structure set forth in the claimed invention except a silicide refractory metal, the bottom layer extending into the substrate less than twice the distance from the top of the bottom layer to the top of substrate. However, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify Chen by a silicide refractory metal, the bottom layer extending into the substrate less than twice the distance from the top of the bottom layer to the top of substrate for the purpose of improving the structure of a semiconductor device, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Response to Arguments

Applicant's arguments filed on 3/4/2003 have been fully considered but they are not persuasive.

With respect to claim 48, applicant argues that De Bruin does not disclose a generally planar layer of a third material covering only the bottom surface, the third material having a graded stoichiometry. However, De Bruin clearly discloses on figure 4 a generally planar layer of a third material 15b covering only the bottom surface, the third material having a graded stoichiometry (col. 6, lines 17-22). Note that layer 15b is still in the structure as shown in figures 4-7 of De Bruin.

With respect to claims 48, 108, applicant argues that Chen does not disclose the layer having the graded stoichiometry comprises "a refractory metal and the first material" of the bottom surface as now recited in amended claim 48 and new claim 108. However, claim 48 only includes the third material having a graded stoichiometry between a refractory metal and the first material, and Chen clearly discloses on figure 3B the third material 36 having a graded stoichiometry between a refractory metal and the first material 31.

With respect to claim 49, the only difference between the claimed invention and Chen is the hole having a high aspect ratio, and Miyamoto discloses on figure 3 the hole having a high aspect ratio (col. 9, lines 3-8). Therefore, the combination of Chen and Miyamoto would read on claim 49.

With respect to claim 71, applicant argues that De Bruin does not even recognize the depletion problem. However, this feature is not even recited in claim 71. De Bruin discloses "a substrate having a profile that does not change significantly in the vicinity of

the contact hole" as recited in amended claim 71 since De Bruin does not teach that a substrate would change significantly in the vicinity of the contact hole.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph Nguyen whose telephone number is (703) 308-1269. The examiner can normally be reached on Monday-Friday, 7:30 am- 4:30 pm

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (703) 308-1690. The fax phone numbers for

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the organization where this application or proceeding is assigned is (703) 308-7382 for regular communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JN

April 2, 2003

A handwritten signature in black ink, appearing to read 'Eddie Lee', is positioned above the printed name and title.

EDDIE LEE
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800